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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY RESEARCH INITIATIVES IN WASTE REDUCTION FOR SMALL QUANTITY HAZARDOUS WASTE GENERATORS

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The US EPA Office of Research and Development is supporting a Small Quantity Generator Research Program to develop and promote the use of innovative technologies and management practices to reduce the generation of hazardous waste. This program was established in response to the needs of small quantity generators in the areas of waste management, regulatory compliance, and technical resources. Waste reduction is seen as a key in helping small businesses by reducing liability, product costs, disposal costs, and environmental, safety and health concerns. To date, a total of three efforts are on-going under this program with the State of North Carolina, the State of Minnesota, and the Governmental Refuse Collection and Disposal Association (CRDCA). Results from each of the three research efforts will be used to assist small businesses work toward waste reduction, improve waste management, and achieve regulatory compliance.

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ABSTRACT

The U.S. EPA Office of Research and Development is supporting a Small Quantity Generator Research Program to develop and promote the use of innovative technologies and management practices to reduce the generation of hazardous waste. This program was established in response to the needs of small quantity generators in the areas of waste management, regulatory compliance, and technical resources. Waste reduction is seen as a key in helping small businesses by reducing liability, product costs, disposal costs, and environmental, safety and health concerns. To date, a total of three efforts are on going under this program with the State of North Carolina, the State of Minnesota, and the Governmental Refuse Collection and Disposal Association (GRCDA). Results from each of the three research efforts will be used to assist small businesses work toward waste reduction, improve waste management, and achieve regulatory compliance.

INTRODUCTION

Small quantity generators (defined as generating less than 1000 kg per month of hazardous waste) often are at a disadvantage in managing toxic and hazardous wastes because of a lack of technical and waste management knowledge, as well as limited economic resources. To respond to this need, the U.S. EPA Office of Research and Development, through the Small Quantity Generator Research Program, is developing and promoting the use of innovative technologies and management practices to reduce/prevent the generation of pollutants. This program has several objectives: 1) to address effective and efficient treatment, storage, collection, transport and disposal of wastes; 2) to establish research programs on the special needs of small businesses and small quantity generators to advise them on waste identification, quantification, management and control alternatives; and 3) to establish research, development, and demonstration projects concerned with the special needs of small businesses and small quantity generators.

Results of this program will provide practical, economical, and sound environmental solutions to assist small businesses in meeting the requirements of state and federal regulations. However, the program emphasizes a non-regulatory means of encouraging industries, especially small businesses and local governments, to use innovative technologies and management practices that reduce pollution and provide economic benefits. A new federal-state-private sector relationship is being fostered by this program that goes beyond the traditional regulatory framework and provides all three parties with an opportunity to work together to solve small quantity generator environmental problems. Although the current

program focuses on hazardous waste and regulatory requirements, the overall program addresses problems with all environmental media, including release of pollutants to air, water and land.

The Hazardous and Solid Waste Amendments of 1984 greatly increased the number of companies (by as many as 130,000) that will be regulated under the Resource Conservation and Recovery Act (RCRA). While the amount of small generator wastes, i.e. approximately 600,000 tons, is only a fraction of the overall hazardous wastes to be regulated, it is nevertheless extremely important because of its potential for polluting the air, water, and land is localized areas, if not managed properly. A survey completed by the U.S. EPA Office of Solid Waste suggests that more than half of these small quantity generators fall into the following five industrial categories: vehicle maintenance, metal manufacturing and finishing, printing, photography, and laundries and dry cleaners. It is apparent that these newly regulated small quantity generators will need practical, cost-effective solutions to their waste management problems.

THE CONCEPT OF WASTE REDUCXTION/WASTE MINIMIZATION

Waste reduction, or waste minimization, is a feasible approach to hazardous waste management for small quantity generators, by reducing the volume of waste generated at the source and reducing reliance on land disposal. The obvious consequences of improper land disposal as a waste management method have been poor management of hazardous waste, groundwater contamination, and other hazards to human health and the environment. Waste minimization, as currently defined by the EPA in its report to Congress, includes any "source reduction" or "recycling" activity undertaken by a hazardous waste generator that results in 1) the reduction of the amounts of hazardous waste that will require treatment or disposal, and/or 2) the reduction of the toxicity of the hazardous waste, so long as such reductions are soncistent with the goal of eliminating or reducing present and future threats to human health and the environment. The Office of Technology Assessment (OTA) submitted its report to Congress in October 1986 defining waste reduction as in-plant practices that reduce, avoid, or eliminate the generation of hazardous waste so as to reduce risks to health and the environment. EPA has also chosen to emphasize "in'plant reduction" as opposed to "off-site recycling" in its research program. In addition, the EPA waste minimization research program has application to the air and water pollution areas, resulting in a multi-media approach.

EPA believes that waste minimization is the best solution to the unique waste management problems of small quantity generators. Waste minimization is more efficient and economically sound and makes more sense than control technologies which are often too expensive to implement. Waste minimization is not only less expensive to implement, but future liability may be reduced.

BENEFITS OF WASTE REDUCTION/WASTE MINIMIZATION

The benefits of waste reduction and proper waste management for small quantity generators are several-fold. Such factors as reducing environmental, health, and safety hazards, future liability, and treatment or disposal costs are potential benefits to the generator under a waste reduction program.

Reducing and recycling wastes can help to alleviate many environmental, health, and safety concerns including worker health and safety, community public health and safety, air and groundwater quality and conservation of natural resources.

The hazardous waste regulations never relieve the generator of responsibility for his waste. The reduction or elimination of hazardous waste generation provides the greatest protection from future liability and clean-up costs. For small quantity generators, a waste minimization program can assist regulatory compliance by reducing or wliminating paperwork, generator fees, and employee notification requirements.

Few companies realize the cost savings which can be achieved from implementing a hazardous waste reduction/recycling program. These cost savings can come from savings on raw materials, reduced transportation costs, and reduced disposal costs. As industrial costs are recovered, the potential for lower consumer costs exists.

RESEARCH PROGRAM PROGRESS TO DATE

The EPA Small Quantity Generator Research Program emphasizes applied research technologies and waste minimization techniques to meet the needs of small quantity generators. This program began in fiscal year 1986, and has developed into three major cooperative agreements with the State of North Carolina, the State of Minnesota, and the Governmental Refuse Collection and Disposal Association (GRCDA).

North Carolina

A cooperative agreement between the U.S. EPA's Office of Research and Development and the State of North Carolina's Board of Science and Technology was established in September 1984 to support a research program addressing the special needs of small waste generators in North Carolina. This research program builds on the North Carolina "Pollution Prevention Pays (PPP) Program" which began in 1983. This PPP Program, in combination with activities of other state agencies, has become a national model. EPA funding has totaled $2000,000, for the three year program, with the State of North Carolina providing matching funds. The program's focus is on specific industries in North Carolina such as the furniture manufacturing industry and wood preservative industry but includes projects in other appropriate areas as well. Many of the projects specific to North Carolina industries will have application to similar waste streams in other parts of the country.

The North Carolina Pollution Prevention Pays Program has several successes in many industrial areas. A total of 35 industrial challenge grants have been supported to date, in the following areas: textiles, furniture finishing, pesticides, printed circuit boards, radial saws, x-ray film, steel smelting, metal stripping, printing, brewing, and electroplating. It is estimated that thirteen North Carolina companies saved about $4.3 million per year from changes in production materials, process modification, waste stream segregation, and recovery for reuse or exchange as a result of applying waste reduction techniques.

The small waste generator research poetion of the program indludes approximately 40 research and demonstration projects which apply waste reduction and pollution prevention techniques. Results to date include reports on:

(1) Managing and recycling hazatrdous solvent waste in the furniture manufacturing industry basically composed of small businesses.

(2) Monographs describing the application of specific pollution prevention techniques to selected state industries and waste streams.

(3) Developing and applying a systematic procedure for the specific identification and control of toxic substances in municipal effluents.

(4) Managing thiosulfate waste from inorganic sulfur-containing waste streams.

Projects for the final year included research on innovative recovery of metals from waste solutions, cost-effective pollution reduction technologies for open mold plastics processing industries, management of household hazardous wastes (i.e. paints, thinners, pesticides), reduction of pesticide waste in surface waters, process identification approaches to manage chlorinated solvents and toxics, managing waste oils as a hazardous waste, and scintillation fluid waste reduction and recycling.

Minnesota

In July, 1986 a two-year $100,000 cooperative agreement was established between EPA and the Minnesota Waste Management Board, a solid and hazardous waste siting agency, to develop a small quantity generator research awards Program (with 50% matching funds) through the Minnesota Technical Assistance Program (MnTAP). The research program is designed to provide small quantity generators of hazardous waste with new methods or technologies for waste reduction, or new applications (including scaling down) of existing technologies. The EPA-supported research program expands on an already established technical assistance program.

The objective of the MnTAP program is to provide technical assistance to small quantity generators in Minnesota to reduce hazardous waste. fIn response to generator needs in Minnesota, MnTAP offers several services to foster and implement waste reduction in industry including telephone consultation, on-site consultation, a student intern program, education, and the research awards program through EPA. The research projects focus on the special needs of Minnesota generators, but have application to generators outside the state. During the first year of the research program, three promising research projects are underway and six more have been initiated in the second year. Each of these projects is summarized below.

The Minnesota Agricultural Aircraft Association (MAAA) is developing engineering plans for aerial and ground pesticide applicators to reuse residues and rinsates brought back from the field, thus reducing the need for disposal of hazrdous wastes. Several waste streams are generated by Minnesota's 215 commercial aerial applicators and 1600 ground applicators, including residual materials remaining in used pesticide containers, tank and spray apparatus rinsate, unused field strength formulation, exterior wash solutions, and unused commercial chemical products. These wastes have historically been disposed of by spraying into an open field or drainage ditch, a practice highly discouraged by regulators. Many of these commercial applicators are small quantity generators, and this project will benefit small generators by providing engineering plans from which to build recycle/reuse systems, and a regulatory guide for use in regulatory compliance.

The University of Minnesota Department of Civil and Mineral Engineering is attempting to use a combination of ultravilet (UV) irradiation and biological treatment to treat metal cyanide complexes from electroplating operations. The first step of the process breaks the metal-cyanide complex by exposing it to ultaraviolet irradiation and the second step detoxifies the free cyanide with nitrogen-fixing blue-green algae. Key results include determination of the cyanide detoxification rates by the algae in order tosize the reactor, which will be used in the economic analysis. This treatment method may be a cost-effective alternative to conventional alkaline chlorination or other forms of treatment, which may be more affordable for small quantity generators. The UV/algae process should be appropriate for treating small volumes of metal-cyanide wastes from small waste generarors due to the higher treatment efficiency achieved using small volumes of waste, low capital and operating costs, ease to maintain, and lack of need for highly trained personnel.

A second ongoing project with the University of Minnesota Department of Civil and Mineral Engineering is evaluating ultrafiltration as a cost-effective method for removal of oily wastes from caustic degreaser solutions. Most engine rebuilding shops, which are usually considered small quantity generators, use hot caustic dip spray tanks to clean engine parts prior to repair. After a period of time, the cleaning solution becomes contaminated with oily wastes, thus reducing its cleaning efficiency. Several membranes have been tested on oil/water emulsions under various operating conditions (i.e. pressure, temperature, feed flow rate) to effectively separate the oil from the caustic solution. Since ultrafiltration has been shown to be an effective treatment technology for removal of oil from numerous industrial wastewaters, its application in the regeneration of caustic degreasing solutions would not only reduce waste generation, but also allow recycle and reduction of product materials used in the preparation of new cleaning solutions.

Circuit Chemistry Corporation is evaluating a unique, low cost method of removing copper and lead from metal finishing waste streams. This involves running copper or lead containing waste through a column of iron or aluminum chips or turnings. The iron or aluminum displaces the copper or lead in the wastewater and the copper or lead precipitates as a relatively pure metal. This project is documenting process variables such as pH, metal concentration, flow rates, contact times, and effect of agitation on removal efficiency. Small quantity generators will benefit from this project because of the potential low cost of aluminum displacement systems, compared to the more expensive alternative systems such as ion exchange, electrolytic recovery, reverse alternative systems such as ion exchange, electrolytic recovery, reverse osmosis, or hydroxide precipitation. The simplicity of operation should also result in low labor requirements, and not require the need for sophisticated in-house ingineering capabilities to operate the system.

The University of Minnesota Department of Environmental Health is examining alternative treatment/disposal methods for chromium laboratory wastes. In laboratories, chromic acid cleaning solution, a mixture of sulfuric acid and potassium dichromate, makes a very strong cleaning agent for laboratory glassware. Disposal of chromic acid cleaning solutions poses a significant problem for academic, clinical, industrial and commercial laboratories, many of which are small quantity generators. At present, the most common disposal practice is landfilling via the lab-pack method. Lab packing refers to packing small volumes

of hazardous waste in a 55 gallon drum in an absorbent material, such as vermiculite. Other options will be researched including substitutions for chromic acid and laboratory treatment techniques.

Washington Scientific Indusstries is developing an integrated waste management scheme to collect, treat, and recycle spent oil/water mixtures for small and medium size machine shops which use aqueous cutting fluid in their machining processes. This waste management plan will result in reduced disposal costs, reduced coolant costs, reduced manpower, reduced liability, and better environmental protection.

The University of Minnesota Department of Civil and Mineral Engineering is investigating removal of solvents from wastewater by ultraviolet (UV) photooxidation. UV induced photolysis is known to be effective for removing a broad range of organic compounds including manmade organics such as chloroform, chlorophenols, and others. Some small quantity generators such as dry cleaners, furniture strippers, and floor strippers are known to discharge wastewaters which contain organic contaminants. Since UV photolysis can destroy a broad spectrum of organics, and is suitable for small scale applications, it may be useful for pretreatment of these industrial effluents. The costs of UV photolysis for treating small volumes of wastewater are likely to be more acceptable to small quantity generators than other technologies with high capital costs such as adsorption, combustion, or air stripping.

The St. Paul Technical Vocational Institute is conducting a study toward the development of an instructive laboratory manual detailing experiments utilizing non-hazardous materials. Alternative experiments which use non-hazardous materials in a teaching environment would eliminate the generation of hazardous waste and thus reduce the associated economic and legislative burden placed upon educational institutions. Other procedures which must use hazardous materials can be redesigned to use smaller quantities.

The University of Minnesota Duluth Natural Resources Research Institute is developing a chemical method to treat the lead in radiator repair wastewaters. An estimated 200 radiator repair shops in Minnesota each generate one to five drums of hazardous sludge each year. Treatment of radiator repair waste by this method has high potential for smaller shops, compared to more expensive options such as hydroxide precipitation, ion exchange, or electrolytic reecovery.

GRCDA

A Small Quantity Hazardous Waste Generator National Information and Assistance Clearinghouse was established through a two-year $200,000 cooperative agreement between EPA and the Governmental Refuse Collection and Disposal Association (GRCDA) in April, 1986. The function of the Clearinghouse is to assist small businesses and other regulated parties in complying with the newly enacted RCRA regulations. Information and assistance will be disseminated through a number of different sources to those who request help. The Clearinghouse will collect existing data on waste management options such as waste reduction techniques to recover and recycle hazardous wastes and proper methods to identify, store, transport, treat, and dispose of those wastes which cannot be eliminated or recycled. This information will then be made available to the small quantity generators through trade associations, states, newsletters and other avenues to

allow them to develop suitable waste management programs. In addition to providing information and assistance, GRCDA will be deveoping a number of case studies to document highly successful state and industry small generator programs. These programs will be applicable to a large portion of the small generator population. Through these efforts, research and development needs will be identified. These research and development needs will help EPA in designing their present and future small generator research and development program.

The second year of the cooperative agreement will be devoted to operating the Clearinghouse, with the dissemination of information upon request and continuing to provide assistance to organizations and establishments in complying with environmental regulations. The Clearinghouse would also include information relative to current research and development efforts and provide updates on the progress of these efforts as results become available. Research resulting from state programs such as those described with North Carolina and Minnesota will be available for dissemination to other states, trade associations and small waste generaotors. At the end of the second year of this program, it is anticipated that the Clearinghouse would be organized in such a manner that businesses in similar groupings would be able to adapt generic approaches to solving their compliance needs. Through the research efforts of the Clearinghouse and others, information would be cataloged on approaches which might have universal application. Through this approach, similar techniques and approaches could be documented and applied generically to the entire group of applicators. At the end of the second year of funding, it is anticipated that the Clearinghouse will be self supporting through user fees.

SUMMARY

Under a more demanding regulatory framework, waste minimization is the most practical and economically feasible approach to hazardous waste management for small quantity generators. Waste minimization results in reduced environmental, health and safety concerns, reduced liability, reduced disposal costs, savings on raw materials, and improved regulatory compliance. The U.S. EPA is ensuring that waste minimization options are developed for and made available to small quantity generators through its Small Quantity Generator Research Program. Currently three research efforts are underway with the State of North Carolina, State of Minnesota, and Governmental Refuse Collection and Disposal Association (GRCDA). These research efforts emphasize a nonregulatory means of getting small industries to use innovative technologies and management practices that can both reduce pollution and provide economic benefits. On a continuing basis, it will be necessary to identify the highest research priorities for small quantity generator problems with aggressive research and management techniques, small businesses will be better prepared to manage their wastes properly. Future EPA research initiatives include expanding the Agency's research, development, and demonstration program in areas related to hazardous waste minimization. This may include assisting specific states in establishing research and technical assistance programs.

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